Acute effect of Kinesio Taping on Knee Joint Biomechanics during Drop Vertical Jump in Anterior Cruciate ligament-Deficient Knee

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Kinesio tape (KT), an elastic therapeutic tape, is useful for prevention and treatment of sport injury, but their efficacies remain unclear on mechanical change. The purpose of this study was to analyze the acute effect of KT on knee joint biomechanics during drop vertical jump in individuals with ACL injuries. Seven participants with partial ACL tears performed drop vertical jump (DVJ) with and without ACL KT taping technique. Peak knee joint angles and moments, and knee joint angle at initial contact were obtained from 3D motion analysis system. Paired t-test did not reveal significant differences of knee joint biomechanics between the 2 conditions. In conclusion, KT did not produce any biomechanical change in participants with partial ACL tears.

KEY WORDS: Kinesio tape, Biomechanics, ACL injury

INTRODUCTION: Anterior cruciate ligament (ACL) injury is one of the most common knee injuries in sports. Neuromuscular control and biomechanics of knee joint have effect on ACL injuries. Athletes with abnormal neuromuscular control of knee joint during cutting or landing task may suffer a non-contact ACL injury. One of the main mechanisms of ACL injuries during sport competition is a forceful valgus collapse with the knee close to full extension, combined with external or internal rotation of the tibia (Olsen et al., 2004). Almost 70% of ACL injuries occur during non-contact situation such as landing from jumping or cutting to different direction (Mclean et al., 2005). Kinesio taping method (KT), an elastic tape developed by Kase, which has been widely used for various purposes including supporting injured muscles and joints, increasing proprioception, relieving pain and improving blood and lymph flow (William et al., 2012). KT has been used for ACL injury treatment by limiting anterior tibial translation. It is believed that KT allows more functional activity as compared to other types of support such as functional knee braces and prophylactic tape. However, previous studies that KT had not change knee joint kinetic and kinematic during running (Howe et al., 2014) and ballet landing (Hendry et al., 2015) when compare with non-taped. Understanding the effect of KT on biomechanical change and neuromuscular response is very important that may help physiotherapist, athletic and healthy people to choose the effective prevention. Therefore the aim of this study to investigate acute effect of ACL kinesio taping on knee joint mechanics during DVJ.

METHODS: Seven participants with partial ACL tears volunteered in this study. The inclusion criteria were ACL-injuries with grade I-II screened by stress X-ray with Telos (Beldame et al., 2012) and MRI. All subjects read and signed informed consent which approved by Ethical Review Board (Faculty of Medicine Ramathibodi Hospital, Mahidol University). All subjects wore standardized running shoes (Adidas, Germany). Participants performed DVJ. During DVJ, participants stood on top of 0.31 m. box. Subjects dropped off the box, landed with each foot on to separated force platform (Kistler Instrument Corp., USA) and then immediately performed a maximum vertical jump with both hands over head. Three valid trials of each period were collected for analysis. Two taping conditions were applied to each participant: 1) KT and 2) Placebo condition (PT). The test was conducted one condition per day and resting period was at least three days each condition. In KT condition, participants were applied a standardized KT technique for ACL injury. It was cut in I shape (0.30 m.) and applied at tibial tuberosity to medial and lateral condyle of femur with 75-100% of tension for limit anterior translation of tibia (Kase, Wallis & Kase, 2003). Whereas PT

condition, participants were applied the same technique with a non-stretchable Kinesio tape. The 3-D LJMU model (Robinson & Vanrenterghem, 2012) was applied during the data collection. 3-D motion analysis (BTS bioengineering, Italy) was used to collect the data. Kinematic and kinetic data were collected at the sampling rate of 200 Hz and 1600 Hz. Visual 3D program (C-motion Inc., USA) was used to derived knee joint angles and moments via inverse dynamic model. Peak knee joint angles and moments were selected from initial contact to take off of first landing of each DVJ. Raw kinematic and kinetic data were filtered through a fourth order low-pass Butterworth filter at cutoff frequency of 20 Hz. Peak knee joint angles and moments between 2 conditions were compared using paired-t test. The level of significance for difference between groups was set at $p< 0.05$.

RESULTS: Knee joint angles and moments data are presented in Table 1. KT group has slightly decreased the mean peak knee abduction angle and moment and knee abduction angle at IC. Mean peak knee flexion angle and flexion angle at IC were increased during DVJ in KT condition. However, no significant differences between the two conditions were observed ($p >0.05$).

Table 1
Knee joint angle at IC, Peak Knee joint angles and moments between KT and PT conditions (Mean and SD)

Variables	KT Mean (SD)	PT Mean (SD)	*p*-value
Kinematic :Angle (Degrees)			
Flexion (-)/ Extension (+) angle at IC	-30.52 (8.78)	-30.35 (14.59)	0.972
Abduction (-)/ Adduction (+) angle at IC	0.32 (0.57)	-1.46 (2.46)	0.063
Peak Flexion (-)/ Extension (+) angle	-101.70 (11.70)	-97.29 (18.91)	0.287
Peak Abduction (-)/ Adduction (+) angle	-7.44 (8.62)	-7.63 (6.98)	0.794
Peak External (-)/Internal rotation(+) angle	10.31 (7.28)	11.43 (8.71)	0.672
Kinetic : Moment (N.m./Kg)			
Peak Flexion (+)/ Extension (-) moment	1.77 (0.27)	1.79 (0.16)	0.529
Peak Abduction (+)/ Adduction (-) moment	0.25 (0.20)	0.27 (0.29)	0.963
Peak External (+)/Internal rotation(-) moment	-0.20 (0.21)	-0.23 (0.27)	0.902

DISCUSSION: This study analyzed the effect of KT on knee joint angles and moments during DVJ. No significant effect of KT on knee movement in ACL-injuries. This finding is similar to the previous studies. Howe et al (2014) found Mulligan's tape (MT) showed a significant decreasing in knee extensor moment whereas no significant on knee kinetic and kinematic between KT and non-tape conditions. MT was rigid tape which applied internal tibial torsion force. However, KT was applied in Y strip, one strip was 25-50% tension over vastus medialis oblique and 75-100% tension on laterally around patella which had aimed to correct the patella alignment. However, there were no significant differences of peak knee joint angles between MT, KT and NT. Whereas Hendry et al (2014) shown only MT reduced posterior knee shear force during two techniques ballet landing. By KT has no effect to reduce posterior knee shear force. However, there was no significant difference in kinetic of knee joint during wide base landing between MT, KT and NT. Because this technique has more stability in task which less alter knee biomechanics by taping technique. It has a theory that justify effect of KT on neuromuscular response. For example, KT stimulated tactile stimulus on cutaneous receptors and facilitated motor unit activation. From this result, it did not produce any biomechanical change in participants with partial ACL tears. The limitation of this study is almost of ACL tear subjects have the complications of other structures. It is very difficult to recruit the isolated ACL tear patients.

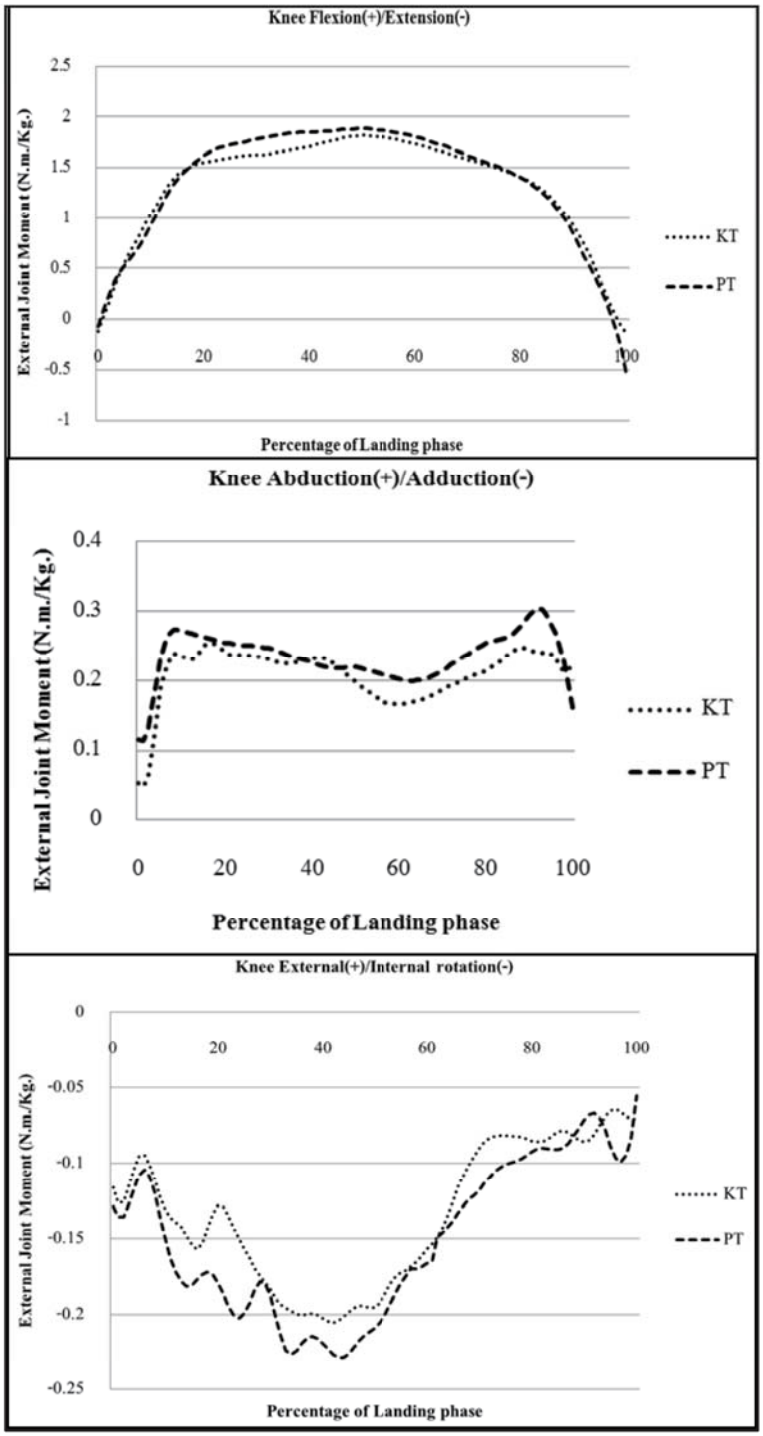

Figure1. Knee joint moments between KT and PT conditions

CONCLUSION: This study did not show significant differences between the two conditions. The application of standardized KT with 75% tension for ACL injury prevention did not changes in knee joint kinematics and kinetics during DVJ in ACL tear patients. Nevertheless, further research with a large sample size is warranted to clarify the beneficial effect of KT on movement control.

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